REMARKS

Claims 10-27 are pending in this application. By this Amendment, claim 10 is amended. Support for the amendment to claim 10 may be found, for example, in the original claims, drawings and specification, particularly on page 3, lines 4-20; page 9, lines 11-19; page 18, line 25 and Figure 1. No new matter is added. In view of the foregoing amendment and following remarks, reconsideration and allowance are respectfully requested.

I. Rejection under 35 U.S.C. §103

The Office Action rejects claims 10-27 as having been obvious over U.S. Patent No. 6,334,896 to Iida et al. ("Iida") in view of U.S. Patent No. 5,685,907 to Fujikawa et al. ("Fujikawa"). However, one of ordinary skill in the art would not have been motivated to combine the teachings of Iida and Fujikawa. Moreover, even if the teachings of Iida and Fujikawa were combined, it would have been impossible to arrive at the claimed invention. Therefore, the rejection is respectfully traversed.

Independent claim 10 requires producing a single crystal by the Czochralski ("CZ") method, wherein, "the single crystal is pulled with controlling a value of V/G ($mm^2/K \cdot min$) within a determined range, and the range of a value of V/G ($mm^2/K \cdot min$), including a desired defect region and/or a desired defect-free region, is determined according to Tmax (°C)," wherein, "Tmax (°C) is the highest temperature of the raw material melt at an interface between a quartz crucible inner wall and a raw material melt." This is also described in the specification at, for example, page 8, lines 8-18. However, none of Iida and Fujikawa, alone or in combination, teach or suggest at least this feature of the claimed invention.

A. There Was No Motivation to Combine the Teachings of Iida and Fujikawa

The Office Action, on page 4, alleges that the "manufacturing method of a single crystal by [the] Czochralski method and [the] vertical gradient freeze (VGF) method have

comparable technical functions." However, Applicants respectfully submit that the two methods as disclosed by Iida and Fujikawa do not have comparable technical functions, and thus, one of ordinary skill in the art would not have been motivated to combine the teachings of the two references.

Fujikawa describes a method for producing a compound single crystal by the Vertical Gradient Freeze ("VGF") method, wherein "ring-shaped heaters in multiple stages provided in a furnace are so controlled as to form a temperature distribution in the furnace which ranges, with lowering position in the furnace, from a high temperature to a low temperature through the melting point of the compound used. By shifting the melting point zone in the temperature distribution upward from a lower position to a higher position, a source material melt in a crucible placed inside the heaters is gradually solidified from its bottom portion in contact with a seed crystal to obtain a single crystal grown." See column 1, lines 31-41.

On the other hand, the present application and Iida describe a method for producing a silicon crystal by the CZ method, as follows: A polycrystalline material is put in a quartz crucible and the crucible is heated by a graphite heater to melt the polycrystalline material in the quartz crucible. A seed crystal fixed by a seed holder connected with a lower end of a wire is immersed into the raw material melt melted from the polycrystalline material. Thereafter, the single crystal having a desired diameter and quality is grown under the seed crystal by rotating and pulling the seed crystal. After bringing the seed crystal into contact with the raw material melt, a process called "necking" is performed, by forming a neck portion by narrowing the diameter to about 3 mm. A dislocation-free crystal is then pulled by spreading to a desired diameter. See page 3, lines 4-20 of the present specification.

As described above, because the CZ method is completely different from the VGF method, the two methods do not belong to the same technical field, as the Office Action asserts. The Office Action's support for this allegation amount to no more than pointing out

broad, generalized similarities between the two methods, such as their common use of "a crucible, a seed and heater" in order to grow a single crystal by "solidification of melted source material which is in contact with the seed crystal." However, the method of producing the single crystal in each technique, and the technical problems associated therewith differ greatly. For example, because in the VGF method, a single crystal is not pulled, the VGF method lacks the parameters of: 1) a pulling rate V of a single crystal (mm/min) in the CZ method, or 2) the value of V/G/(mm^2/k • min). Accordingly, one of ordinary skill in the art practicing the CZ method according to Iida, seeking to improve the single crystal production as a function of both pulling rate and temperature gradient, would not have been motivated to turn to the teachings of Fujikawa, in order to arrive at the invention of the present claims.

B. Iida and Fujikawa Do Not Teach or Suggest the Claimed Invention

Even if the cited references were improperly combined, the combination still would not have rendered obvious the claimed invention.

At most, Iida describes a method for producing a silicon single crystal by the CZ method, wherein the "crystal is pulled with such conditions as present in a region defined by a boundary between a V-rich region and an N-region and a boundary between an N-region and an I-rich region in a defect distribution chart showing defect distribution which is plotted with D [mm] as abscissa and F/G [mm^2/°C • min] as ordinate, wherein D represents a distance between center of the crystal and periphery of the crystal, F [mm/min] represents a pulling rate and G [°C /mm] represents an average temperature gradient along the crystal pulling axis direction in the temperature range of from the melting point of silicon to 1400°C, and time required for crystal temperature to pass through the temperature region of from 900°C to 600°C is controlled to be 700 minutes or shorter." See column 2, line 64 to column 3, line 14. However, Iida does not teach or suggest a "single crystal [being] pulled with controlling a value of V/G (mm^2/K • min) within a determined range," wherein

"Tmax (°C) is the highest temperature of the raw material melt at an interface between a quartz crucible inner wall and a raw material melt," as required by claim 10.

Furthermore, the Office Action, on page 3, alleges that Fujikawa, in column 10, lines 35-42 describes "a highest temperature at an interface between a crucible and a raw material melt... defined as Tmax (°C)." However, Applicants respectfully submit that this is an inaccurate characterization of Fujikawa's disclosure.

Instead, Fujikawa describes in column 10, lines 35-42, that if a single crystal is subjected to a large temperature gradient, it is likely that a transformation, which may be turned into a defect by thermal stress, as well as variation in composition, will result. See column 10, lines 35-42. Thus, the "temperature" described in this portion of Fujikawa refers to the temperature distribution in the portion wherein the source material melt is contacted with the seed crystal in the process of gradually solidifying the source material melt from its portion in contact with the seed crystal and growing the single crystal. See column 10, lines 27-29. Therefore, Fujikawa does not teach or suggest the highest temperature at an interface between a crucible and a raw material melt being defined as Tmax (°C), as the Office Action alleges.

Because the teaching of Fujikawa lacks both: 1) the parameter of a pulling rate V of a single crystal (mm/min) used in the CZ method, and 2) controlling a value of V/G ($mm^2/K \cdot min$), neither Iida nor Fujikawa, alone or in combination, teach or suggest "the range of a value of V/G ($mm^2/K \cdot min$) including a desired defect region, and/or a desired defect-free region being determined according to Tmax (°C)," wherein, "Tmax (°C) is defined as the highest temperature at an interface between a quartz crucible inner wall and a raw material melt." However, Fujikawa and Iida, alone or in combination, fail to teach or suggest at least the above limitations, nor any benefits that would be provided by the use thereof. Therefore, none of Fujikawa and Iida, alone or in combination, would have rendered obvious

independent claim 10, and claims 11-27, which depend therefrom. Accordingly, reconsideration and withdrawal of the rejection are respectfully requested.

II. Conclusion

In view of the foregoing, it is respectfully submitted that this application is in condition for allowance. Favorable reconsideration and prompt allowance of this application are earnestly solicited.

Should the Examiner believe that anything further would be desirable in order to place this application in even better condition for allowance, the Examiner is invited to contact the undersigned at the telephone number set forth below.

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